

CLMPTO 09/23/04 JW

Cancel Claims 12-16,18-23,40,

Amend Claims 45,

Add Claims 47,

This listing of claims will replace all prior versions, and listings, of claims in the application:

1 (WITHDRAWN): An optical element in which an angle between a $[100]$ axis of an isotropic crystal and an optical axis is less than 10° .

2 (WITHDRAWN): An optical element in which an angle between a $[001]$ axis of an isotropic crystal and an optical axis is 0° .

3 (WITHDRAWN): An optical element in which an angle between a $[001]$ axis of an isotropic crystal and an optical axis of an optical system using the optical element is less than 10° , and preferably 0° .

4 (WITHDRAWN): An optical element in which an angle between a $[001]$ axis of an isotropic crystal and an optical axis of an optical system using the optical element is 0° .

5 (WITHDRAWN): A manufacturing method for an optical element comprising the steps of:
growing an isotropic crystal; and
forming the optical element from the isotropic crystal that has been grown,
wherein the growing step includes the step of controlling growth so that a free
orientation of the growing crystal is $<10^\circ$ ($>0^\circ$).

6 (WITHDRAWN): A manufacturing method for an optical element comprising the steps of:

growing an isometric crystal; and
forming the optical element from the isometric crystal that has been grown,
wherein the forming step is performed by sliding the isometric crystal parallel to a
(0 0 1) face of the crystal.

7 (WITHDRAWN): An optical element that is manufactured by a manufacturing method
according to claim 5.

8 (WITHDRAWN): An optical element according to claim 7, wherein an angle between a [0 0
1] axis of an isometric crystal and an optical axis of the optical element and/or an optical axis of
an optical system using the optical element is less than 10°.

9 (WITHDRAWN): An optical element according to claim 8, wherein an angle between a [0 0
1] axis of an isometric crystal and an optical axis of the optical element and/or an optical axis of
an optical system using the optical element is substantially 0°.

10 (WITHDRAWN): An optical element according to claim 6, wherein the isometric crystal is
fluoride.

11 (WITHDRAWN): An optical system according to claim 10, wherein the isometric crystal is
any one of calcium fluoride, barium fluoride, and strontium fluoride.

12-16 (CANCELLED):

17 (PREVIOUSLY PRESENTED): A projection optical system including more than one of the
optical elements of a plurality of optical elements made of isometric crystals in which an angle

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between each $[001]$ axis of the isotropic crystals and an optical axis of the optical system is less than 10° , the number of the optical elements is n , wherein the optical elements are located with one displaced from another around the optical axis so that an $[010]$ axis perpendicular to the $[001]$ axis of one of the optical elements and an $[010]$ axis perpendicular to the $[001]$ axis of another of the optical elements form an angle within $90 \pm 10^\circ$ with each other.

19-23 (CANCELLED):

24 (PREVIOUSLY PRESENTED): An optical system including a plurality of optical elements made of isotropic crystals in which an angle between each $[110]$ axis of the isotropic crystals and an optical axis of the optical system is less than 10° , wherein said plurality of optical elements includes at least two optical elements of which axes perpendicular to the $[110]$ axes are not parallel to each other.

25 (PREVIOUSLY PRESENTED): An optical system according to claim 24, wherein the angle between the axis of the isotropic crystals and the optical axis is substantially 0° .

26 (ORIGINAL): An optical system according to claim 24, wherein the more than one of the optical elements is substitutive for an optical component derived from division of the optical elements in a plane perpendicular to the $[110]$ axis.

27 (ORIGINAL): An optical system according to claim 24, wherein the optical system includes two of the optical elements, and a relative angle of axes of the two optical elements perpendicular to the $[110]$ axis is 90° .

isotropic crystal is less than 10° in optical elements except the more than one of the optical elements in the projection optical system.

35 (PREVIOUSLY PRESENTED): A projection optical system according to claim 31, wherein an angle between any one of an $[111]$ axis and an $[001]$ axis of an isotropic crystal, and an optical axis is less than 10° in optical elements except the more than one of the optical elements in the projection optical system.

36 (ORIGINAL): A projection optical system according to claim 34 including more than one of the optical elements according to claim 34, forming a first set of optical elements,

wherein a second set of optical elements within the first set of optical elements have the $[001]$ axis substantially parallel with each other;

wherein the rest of the first set of optical elements, forming a third set of optical elements, have the $[001]$ axis substantially parallel with each other and perpendicular to the $[001]$ axis of the second set of optical elements; and

wherein a difference between a total thickness (algebraic thickness on axis) of the second set of optical elements and a total thickness of the third set of optical elements is less than 10 μ m.

37 (ORIGINAL): A projection optical system according to claim 33, wherein a relative angle of axes perpendicular to the optical axis of the optical elements except the more than one of the optical elements in the projection optical system is changed to reduce intrinsic birefringence.

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38 (PREVIOUSLY PRESENTED): An optical system according to claim 24 that uses a light source of which the wavelength is 200nm or shorter.

39 (ORIGINAL): A projection optical system according to claim 38, wherein the light source is any one of an ArF excimer laser and an F₂ excimer laser.

40 (CANCELLED):

41 (PREVIOUSLY PRESENTED): An optical system according to any one of claims 17 or 24-39, wherein the optical element is one of a lens, a diffraction grating, a parallel flat plate, an optical film, and a combination thereof.

42 (ORIGINAL): An exposure apparatus that uses ultraviolet radiation, deep ultraviolet radiation, or vacuum ultraviolet radiation as exposure light, which is projected onto an object to be processed through the optical system according to claim 41 to expose the object to be processed.

43 (WITHDRAWN): A device manufacturing method comprising the steps of:
projecting the light for exposure onto the object to be processed using the exposure apparatus according to claim 42; and
performing a predetermined process against the object to be processed in which the light has been projected and exposed.

44 (PREVIOUSLY PRESENTED): A projection optical system for projecting a pattern of a mask, said projection optical system comprising a plurality of optical elements made of isotropic

crystals in which an angle between each $[001]$ axis of the hexametic crystals and an optical axis of the projection optical system is less than 10° ,

wherein the pattern on the mask includes a repetitive pattern and a repetitive direction of the repetitive pattern differs from directions of $[100]$ and $[010]$ axes that are perpendicular to the $[001]$ axis of the hexametic crystals.

43 (CURRENTLY AMENDED): A projection optical system for projecting a pattern on a mask, said projection optical system comprising a plurality of optical elements made of hexametic crystals in which an angle between each $[001]$ axis of the hexametic crystals and an optical axis of the projection optical system is less than 10° ,

wherein the pattern on the mask includes a repetitive pattern and a repetitive direction of the repetitive pattern differs from one of angles of 0° , 45° , and 90° with respect to a primary direction on a plane that includes the mask, and

wherein directions of $[100]$ and $[010]$ axes that are perpendicular to the $[001]$ axis of the hexametic crystal differ from the primary repetitive direction.

46 (PREVIOUSLY PRESENTED): An optical system according to any one of claims 44 or 45, wherein the optical element is one of a lens, a diffraction grating, a parallel flat plate, an optical fiber, and a combination thereof.

47 (NEW): An exposure apparatus that uses ultraviolet radiation, deep ultraviolet radiation, or vacuum ultraviolet radiation as exposure light, which is projected onto an object to be processed through the optical system according to claim 46 to expose the object to be processed.